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# CATFISH PROCESSING..

## A Rising Southern Industry



## ABSTRACT

This study describes the catfish processing industry in nine Southern States in 1970, and attempts to determine factors affecting the economic operation of the 16 plants surveyed. The infant industry--only three of the 16 processors marketed any fish prior to 1968--is still experimenting with different processing and marketing methods. Processing methods include hand labor, machine use, and a combination of both. About 98 percent of the product was sold wholesale in 1970. Obtaining a steady supply of fish--especially in slack summer months--to increase utilization of capacity is the major problem facing the industry. In contrast to a total capacity of 21.3 million pounds (live weight), the plants only processed 6.4 million pounds in 1970.

Key Words: Catfish, South, Processing plants, Supply, Byproducts, Wholesale-retail marketing, Price-demand relationships.

## PREFACE

This report is based on a 1970 study conducted by the Economic Research Service (ERS), U. S. Department of Agriculture (USDA), to make an economic appraisal of the catfish processing industry in nine Southern States as part of its technical assistance program in Resource Conservation and Development (RC&D) Projects.

The RC&D program, administered by the Soil Conservation Service, is a USDA program designed to promote economic development in rural areas. As a participant in this program, ERS conducts studies to provide economic information to planning units in authorized RC&D areas. Study results have broad applicability within a particular RC&D area or in the national RC&D program. The catfish industry, owing to its rapid expansion since 1967, is important to the RC&D program because it presents possibilities for utilization of unemployed and underemployed land, water, and labor resources in the rural South. The report should be useful to those contemplating investment in the catfish processing industry, lenders and credit institutions serving the industry, and others involved in activities associated with production and marketing of catfish.

Appreciation is extended to the commercial catfish processing firms whose cooperation in providing information made this research possible. The author also expresses his gratitude to the following members of the Department of Agricultural Economics, Georgia Agricultural Experiment Station, Experiment, Ga., for their assistance and contribution to the study: J. C. Purcell; D. W. Parvin, Jr.; J. C. Elrod; L. W. Hicks; and Mrs. Velma Patton. The assistance of Neil R. Cook, leader of the Southern Resource Group of the Natural Resource Economics Division (NRED) of ERS, in planning and conducting the research is gratefully acknowledged. Appreciation also is extended to Dwight M. Gadsby, NRED, Washington, D. C., and Clifford Jones, NRED, Little Rock, Ark., for their helpful suggestions.

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## SUMMARY

The catfish processing industry in the South--despite restrictions of unsteady supply and low profit margins--envisioned continued economic growth.

This industry has emerged in the South since 1967 in response to the rapid increase of acres devoted to catfish production. Only three of the 16 processing plants in nine Southern States reported marketing any fish prior to 1968. Two plants began operation in 1968, 10 in 1969, and one in 1970. All 16 plants cooperated in the 1970 USDA survey.

The total operating capacity of these processing facilities in 1970 was 21,332,000 pounds (live weight). The quantity of live fish utilized by these plants was only 6,353,166 pounds, or approximately 29 percent of capacity. Lack of constant catfish supply, especially in the spring and summer months, was a major factor in the low utilization of facilities.

The plants used three different processes to skin and dress fish. Seven used machines for skinning; seven used hand skinning only; and two used hand and machine methods. The average volume of fish (live weight) processed per manhour was 54.6 pounds for plants using hand skinning, 72.2 pounds for those using machines, and 58.3 pounds for plants using both hand labor and machines.

The total volume of sales of processed fish for all plants amounted to 3,686,160 pounds in 1970. The total value was \$3,157,427--at an average price of 86 cents per pound. About 98 percent of these sales went to the wholesale market. Fresh fish accounted for 50.6 percent of the total volume of whole-sale sales, while 49.4 percent was sold as a frozen product--a ratio of 1:1 for total sales. This ratio, however, varied considerably during the year--especially in the slack summer months.

The byproduct (waste) of catfish processing--accounting for 40-45 percent of the live weight--was sold by only five processors. The price they received was only 2-3 cents per pound.

Most processors viewed the lack of constant supply of fish for processing as their most serious problem. Purchases of live fish in April, May, and June in 1970 accounted for only 7.6 percent of annual purchases of all plants.

According to the processors, the catfish industry would receive the most benefit from additional research in the following areas: (1) Improvement of the management and efficiency of catfish producers; (2) processing technology--better skinning and dressing equipment; and (3) catfish breeding and genetics. The area of marketing--especially with respect to consumer preference--and the extension of the base of marketing beyond the Southern States--also were recognized as contributing factors in the economic growth of the industry.

CATFISH PROCESSING--A RISING  
SOUTHERN INDUSTRY

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INTRODUCTION

The catfish industry in the South is undergoing rapid change. In 1963, eight States reported only 2,370 acres devoted to commercial catfish production. In 1969, commercial catfish production used 40,000 acres in 12 States, representing a 40-percent increase over the total in the previous year. Harvested area for 1970 was estimated to be 54,000 acres (1). 1/

The fast-paced growth of the southern catfish industry can be attributed to its adaptability to the climate of the region, land resources, the ease with which producers are able to fit labor and capital requirements of catfish production into ongoing farm operations, and a strong initial market for catfish.

Farm-raised catfish in the mid-sixties were mostly sold to live haulers; some went to local consumers. As production expanded, another form of market was needed. Accurate data are not available on the amount of fish marketed through other sources such as those purchased for fish-out ponds. However, 90 percent of the 1967 production was marketed through live haulers and local consumers (2).

A critical link in the marketing chain is the processor. As catfish production increased and markets broadened, processing became more important and processing problems and costs more critical to the growth of the new industry. Since 1967, in response to greater catfish production, the number of processing plants has increased to 16, located in nine States.

The following economic evaluation of the southern catfish processing industry in 1970 was made in direct response to both the rapid growth of catfish farming and the importance of processing in further developing a market for the increased production.

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1/ Underscored numbers in parentheses refer to items listed in the Literature Cited.

## Objectives

The objectives of this study were to: (1) Determine the economic structure of the southern catfish processing industry in 1970, (2) determine the major outlets for the finished product, and (3) identify factors affecting processing costs and marketing of the finished product.

## Methodology

Questionnaires and personal interviews were used to collect data for the study. Sixteen processors in nine Southern States were interviewed and completed questionnaires. The 16 plants accounted for all known processors of farm-raised catfish in these States in 1970. The data were used to identify economic problems existing in catfish processing in 1970. No definite costs were developed because of the relatively short life of the processing industry. Data were used to describe the characteristics of the industry, to delineate problems peculiar to the industry, and to identify critical economic factors affecting the future success of processing farm-raised catfish.

### CHARACTERISTICS OF THE CATFISH PROCESSING INDUSTRY

Because of the recent upsurge in farm-raised catfish production, live weight sales to live haulers and other buyers could no longer offer an adequate outlet for the increased output. The need for market outlets for a product meeting the requirements of the food market necessitated the development of the catfish processing industry. The following paragraphs describe the significant features of this industry in 1970.

#### Ownership and Span of Operations

The 16 processing facilities had four types of ownership: (1) Five were owned by individuals; (2) five were owned by corporations; (3) five were cooperatives; and (4) one plant was formed as a partnership. Only three of the 16 plants sold any processed fish prior to 1968. Two plants began operation in 1968, 10 in 1969, and one in 1970

#### Capital Requirements

Because of the many changes in operations of the processing facilities in 1970 and the relatively new development of these facilities, no effort was made to itemize investments by land, buildings, and equipment. The total investment was considered sufficient for purposes of this report.

Total investments varied widely among the 16 plants (table 1). Three plants had an investment of less than \$50,000, with an average investment of \$21,333. Two larger plants in the category of \$500,000 and over had an



average investment of \$875,000. Total investments ranged from \$12,000 to approximately \$1 million.

Harvesting equipment was another important investment for the processor. Fourteen processors reported owning their own harvesting equipment, which usually consisted of a tank truck (for hauling live fish) and a vehicle to carry seines, scales, and other smaller equipment. Investments of these 14 plants for harvesting equipment ranged from a low of \$6,000 to a high of about \$20,000--averaging \$10,286 per plant.

### Functions and Activities

The primary function of all processing facilities was to process farm-raised catfish. However, two of the 16 plants reported processing some wild catfish (from streams and lakes) and other species of fish. The features and operations of the 16 processing facilities, which changed considerably in 1970, are described in the following paragraphs.

Harvesting.--Practically all the fish purchased for processing were produced and harvested from ponds (see fig. 1). Some raceways <sup>2/</sup> were constructed for production in 1970 and were stocked, but none of the plants reported purchasing any fish grown in raceways. The harvesting procedures were all directed toward pond-produced fish.

Labor arrangements for harvesting varied considerably among the plants. Each plant seemed to have its own arrangements and no special pattern was apparent. In practically all cases, the processing plant furnished at least two employees--a tank truck driver and one other man. Fourteen plants with harvesting equipment employed 36 persons during the harvesting operation. Not all these individuals were employed only for harvesting operations. They usually were regular employees who had other responsibilities and worked with harvesting only at peak seasons.

Harvesting costs were extremely difficult to determine because labor use and costs varied so much. In some cases, the plants supplied all labor for harvesting; in others, they furnished only two employees and equipment and the producer supplied all other labor. Some plants reported charging a harvesting cost in all months except summer months, when they would supply the equipment, truck, and driver free. Plants removed charges in the summer to encourage a supply of fish in these months when the poor survival rate of catfish in the hot weather makes it difficult to obtain a sufficient amount

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<sup>2/</sup> A raceway is a trench-like structure divided into segments. Water is supplied by gravity flow. Catfish are grown in these raceways to ease harvesting.

Table 1.--Range of total investments in 16 catfish processing plants in the South, by number of plants and average investments, 1970

Amount of investment	Catfish processing plants	Average investment
	<u>Number</u>	<u>Dollars</u>
Less than \$ 50,000.....	3	21,333
\$ 50,000 - \$149,999.....	6	80,000
\$150,000 - \$249,999.....	3	206,667
\$250,000 - \$349,999.....	2	275,000
\$350,000 - \$449,999.....	0	--
\$550,000 and over.....	2	850,000



Figure 1.--Catfish harvesting operations at a farm. Fish are weighed and lifted from pond by use of winch and boom.

of fish. The following examples of charge rates show how processing plants differ in their charge methods:

- (1) Charge 2-3 cents per pound plus 15-25 cents per mile for truck use.
- (2) Charge flat rate of 5 cents per pound for harvesting and hauling.
- (3) Charge for harvesting equipment and labor (usually 3-4 cents per pound, depending on the time and difficulty).
- (4) Did not charge for harvesting in 1970, but plan to charge in 1971.
- (5) Pay 2 cents per pound above normal price if the producer delivers his own fish to the plant.
- (6) Furnish truck and driver free of charge; producer pays other costs.

Purchasing Fish for Processing.--Data for this section were recorded as the actual amount of farm-raised catfish purchased for processing. The information was obtained from plant records and from estimates by plant managers or other responsible persons. The monthly price paid, which does not include charges for harvesting, is reported as the price per pound (live weight) at the processing plant.

The amount of live fish purchased by the processing plants varied considerably by season (table 2). Purchases in winter months (January, February, and March) represented approximately 41 percent of total purchases, while those in the spring (April, May, and June) accounted for only 7.6 percent of annual purchases. Processors obtain an extremely small supply of catfish in the spring/summer season. The months of May through August accounted for only 11.2 percent of annual purchases. As indicated earlier, these months are not conducive to harvesting because of the high probability that the fish will die during harvest due to the relatively high temperatures.

The price paid for live catfish ranged from a low of 32 cents per pound in November and December, 1970, to a high of 39 cents per pound in July (table 2). Producers received higher prices for their product in the period of low supply--May, June, July, and August. The 16 processing plants paid \$2,206,934.73 for 6,355,916 pounds of catfish in 1970--at an average price of 35 cents per pound.

Processing Capacity.--The processing capacity of each plant is specified as the pounds of live weight catfish that can be processed in one 8-hour shift, operating at peak capacity. In reporting the number of persons employed in processing, the count includes those actually involved in skinning, cleaning, and packing of catfish, and the supervisory personnel involved in these operations. It does not include clerks and administrative personnel.

Table 2.--Volume and value of catfish purchased for processing, by month,  
16 processing plants in the South, 1970

Month	Volume purchased 1/	Price per pound	Value
	Pounds	Dollars	Dollars
January.....	799,459	0.36	288,051.93
February.....	1,217,931	.36	437,704.51
March.....	593,005	.36	210,689.40
April.....	237,924	.36	85,093.58
May.....	96,040	.37	35,468.64
June.....	147,141	.37	54,770.89
July.....	223,748	.39	86,390.34
August.....	246,388	.38	94,703.16
September.....	422,254	.34	144,340.40
October.....	780,304	.34	262,431.21
November.....	819,599	.32	261,256.93
December.....	772,123	.32	246,033.74
Total.....	6,355,916	.35	2,206,934.73
1/ Live weight.			

The daily output for one 8-hour shift varied widely among plants (table 3). Five plants processed less than 3,000 pounds (live weight) per plant per shift, with an average of about five employees per plant. The four larger plants had an output of over 12,000 pounds per plant per shift. These plants employed about 25 workers per plant in the actual processing operation.

Assuming maximum operation of 5 days per week for 52 weeks and allowing 10 days (2 weeks) for vacation, a plant could operate a total of 250 days. The normal operating capacity would be approximately 80 percent of maximum capacity.

Within this framework, 15 processing plants reported their estimated capacity to be approximately 21.3 million pounds (live weight) of catfish per year. One processor could not estimate his capacity of production because his small facility had a very irregular operation. The 15 plants processed about 6.4 million pounds (live weight) of catfish--approximately 29 percent of their capacity.

Dressing Facilities.--The dressing facilities of catfish processing plants varied considerably in type, size, and assembly. Many plants planned to make adjustments in 1970/71 to increase the efficiency of their operation.

Table 3.--Processing capacity of 16 catfish processing plants in the South, by number of plants and employees, 1970

Volume <u>1/</u>	Catfish processing plants	Total number of employees
	<hr/> -----Number-----	
Less than 3,000.....	5	26
3,000 - 5,999.....	0	0
6,000 - 8,999.....	4	37
9,000 - 11,999.....	2	41
12,000 and over.....	4	103
No data.....	1	20

1/ Volume in live weight pounds for one 8-hour shift.

Dressing catfish consists of heading, gutting, and skinning, which can be done by hand, machine, or some combination of both methods (see figs. 2 and 3). Seven processing plants used machines for skinning and seven used hand dressing only. Two plants reported using both machine and hand dressing. Two types of machines were used for dressing in early 1970, but only one type was in use at the end of the year. Most plants now use the type of machine that follows the sequence of heading, gutting, and skinning. Heading is done with a bandsaw; gutting is done by hand; and machines are used for skinning. In the hand-skinning operation, the fish is skinned, then headed, and finally, gutted and cleaned. In most cases, all gutting and cleaning are done by hand.

Marketing Processed Fish.--The marketing of catfish by processors appeared to be in an experimental stage in 1970. Several plants completely reorganized their marketing practices during the year. Many tried marketing various sizes of fish in different types of packages. Some reported that marketing through distributors gave best results; others attempted to deliver their own product.

None of the 16 plants reported having any types of contract with restaurants or other outlets for the complete marketing of their product. Many stated that they considered such agreements advantageous, but that the supply of catfish from producers was not steady enough to satisfy the requirements of such agreements. Some processors reported entering into a verbal agreement with an establishment to supply it with fish and then were unable to fulfill their obligation. As a result, they lost the customer.



Figure 2.--Skinning and dressing procedure. Fish enter from holding tank and two bandsaws remove heads. The insides are partly removed by hand, and the rest sucked out by vacuum. Two skinning machines skin the fish. Employees then wash and remove any skin left from the machines and place the fish in a rotating cup.

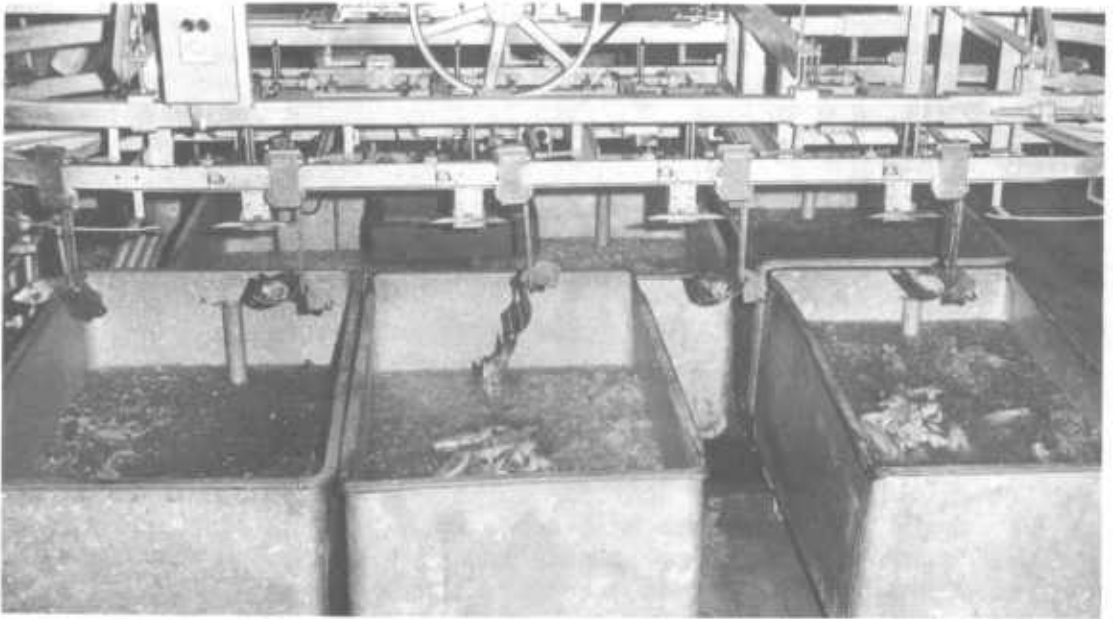


Figure 3.--Automatic sorting basins where fish are dropped in ice-filled tubs according to size.

## Disposition and Distribution of Processed Fish

Processing plants distributed their fish through many different outlets. All processors altered their methods of distribution considerably during 1970.

Direct Delivery to Customers.--Only nine of the facilities reported delivering any portion of the processed fish. These plants delivered within a radius of 40-100 miles. Most of them were planning to increase both their range of delivery and the proportion of total volume delivered.

Sales Through Food Brokers and Distributors.--Nine processors reported marketing processed fish through food brokers. Most of these plants sold part of their output to one distributor or broker and the remainder through other outlets. Some reported selling to brokers in one period, but changing to other outlets during the year. Because of the changes in distribution that occurred during the year, it was not possible to calculate the exact volume of fish sold through this outlet. However, sales records reveal that at least 1,761,438 pounds of processed fish were sold through distributors or brokers in 1970. This figure represents approximately 48 percent of the total sales of the 16 processing plants.

Sales to Restaurants.--Because of the diversity of the processor's marketing practices, it is difficult to trace the volume of sales to any particular outlet. In cases where some catfish production was marketed through brokers or distributors, the processor could not estimate the volume of such sales to restaurants, stores, etc. However, 14 processors reported selling 896,389 pounds, or about 24 percent of total sales, directly to restaurants. This figure excludes the volume represented by sales through brokers and distributors.

Distribution by Size.--Fifteen of the 16 plants reported sorting their output by size. In no case did a plant indicate that it weighed individual fish for sorting. 3/ All sorting decisions were made by an individual on the processing line. Catfish were classed as small, medium, and large, with no special weight designating a given category. Only one plant reported charging varying prices for different sizes of fish.

## Methods of Sales

The quantity sold as processed fish was tabulated by month for each plant (table 4). Total sales were broken down into wholesale and retail sales. Wholesale sales are defined as the volume sold to distributors, brokers, restaurants, and stores. Retail sales are those sold in small volume to individuals who usually pick up the product at the plant. Whole-

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3/ Since the field work was completed for this study, at least one plant has begun to implement new technological features such as weighing devices.

sale sales are further divided into fresh and frozen categories. Fresh fish are processed fish that were not frozen and usually were stored only a short time in the processing plant. Frozen fish is the volume frozen at the plant. Usually, they are stored in the plant. No attempt was made to separate sales according to the size of the package.

Total Sales.--The total volume of processed catfish sold in 1970 amounted to 3,686,160 pounds, averaging 86 cents per pound (table 4). The monthly volume varied from a low of 84,443 pounds in May to a high of 524,946 pounds in February. The volume of sales by month corresponds very closely with the volume purchased for processing. Sales in May, June, July, and August combined accounted for 13.6 percent of annual sales (table 4). Purchases in these same months accounted for 11.2 percent of the annual volume of fish purchased in 1970 (table 3).

Table 4.--Total sales of all processed catfish, by month, 16 processing plants in the South, 1970

Month	Volume sold 1/	Price per pound	Total value
	Pounds	Dollars	Dollars
January.....	416,952	0.87	363,019.35
February.....	524,946	.86	450,085.20
March.....	374,318	.84	314,853.75
April.....	257,180	.82	211,504.35
May.....	84,443	.85	72,040.50
June.....	104,764	.87	91,046.85
July.....	151,134	.84	126,229.24
August.....	161,066	.84	135,607.97
September.....	242,718	.86	207,709.43
October.....	445,970	.86	385,302.93
November.....	475,819	.86	410,763.13
December.....	446,850	.87	389,264.30
Total.....	3,686,160	.86	3,157,427.00

1/ Dressed and processed.



The price received for catfish varied from a low of 82 cents per pound in April to a high of 87 cents in January, June, and December. In the last 4 months of 1970, the price appeared to be stabilizing at about 86 cents per pound. Production also appeared to become more stable in the last 3 months--October, November, and December. Perhaps the plants were utilizing all the available supply of fish in this period when the major catfish harvesting is done in the South (table 3).

Wholesale and Retail Sales.--The wholesale volume--both fresh and frozen--accounted for 98.7 percent of total processed sales in 1970 (table 5). As shown in tables 3 and 4, the volume of fish purchased and sold evidenced the same seasonal pattern. The price of wholesale fish was, in most cases, the same as that shown for all sales because the retail volume was too small to have an effect on the average price received for all fish.

The retail volume of catfish sales only accounted for 1.3 percent of total sales (table 5). These fish usually were picked up at the processing plant by local people for their personal use. Retail prices varied from a low of \$0.93 per pound in December to a high of \$1.02 per pound in June. However, the volume of retail sales, by month, corresponded closely with wholesale sales.

Fresh and Frozen Sales.--In 1970, the sale of fresh processed catfish accounted for 50.6 percent of the total volume of wholesale sales, while 49.4 percent was sold as a frozen product (table 6). The ratio of fresh to frozen fish was about 1:1 for total sales, but, varied considerably during the year. For example: In the first 3 months (January, February, and March), 360,215 pounds of fish sold as wholesale were fresh fish, representing 27.6 percent of total wholesale sales. In the last 3 months (October, November, and December), fresh sales accounted for 75.9 percent of the total wholesale volume. This upsurge in fresh sales is evident soon after the slack summer months.

Fresh fish sold for about 90 cents per pound, compared with 81 cents for the frozen product--an average of 9 to 10 cents more each month than the price of frozen fish.

Sales of fresh fish sold as retail accounted for 39.8 percent of total retail sales in 1970 (table 7). There also was some variation in the proportion of retail sales sold as fresh fish between the seasons. For example, in the first 3 months, fresh sales accounted for only 19.3 percent of the total volume sold at retail. In the last 3 months, sales of fresh fish represented 51.7 percent of total retail sales. The increase in proportion of fresh sales for retail trade followed the same pattern as total sales and wholesale sales.

Table 5.--Sales of processed catfish, by wholesale and retail categories and by month, 16 processing plants in the South, 1970

Month	Processed catfish sold as:					
	Wholesale			Retail		
	Volume	Price	Total	Volume	Price	Total
	sold 1/	per pound	Value	sold 1/	per pound	Value
	Lb.	Dol.	Dol.	Lb.	Dol.	Dol.
January.....	412,599	0.87	358,821.30	4,353	0.96	4,198.05
February.....	520,675	.86	445,948.60	4,271	.97	4,136.60
March.....	370,803	.84	311,535.00	3,515	.94	3,318.75
April.....	254,098	.82	208,554.65	3,082	.96	2,949.70
May.....	81,843	.85	69,410.50	2,600	1.01	2,630.00
June.....	102,864	.87	89,116.85	1,900	1.02	1,930.00
July.....	149,534	.83	124,729.24	1,600	.94	1,500.00
August.....	159,266	.84	133,877.97	1,800	.96	1,730.00
September.....	237,618	.85	202,904.43	5,100	.94	4,805.00
October.....	439,838	.86	379,534.33	6,132	.94	5,768.60
November.....	469,864	.86	405,163.13	5,955	.94	5,600.00
December.....	441,975	.87	384,719.30	4,875	.93	4,545.00
Total	3,640,977	.86	3,114,315.30	45,183	.95	43,111.70

1/ Dressed and processed.

In the first 6 months of 1970, the price of fresh fish versus frozen fish differed about 18 cents a pound except in May, when there was a 14-cent difference. During the last 6 months, the price difference between fresh and frozen sales was only about 10 or 12 cents.

Fish Sold as Fillet.--The processing industry has very little information about consumer preference. However, some processing facilities have tried to market various types of packages. Three plants reported regular sales of fillet in 1970, totaling 21,970 pounds. Some did not keep records but indicated that their attempts to market catfish fillet were unsuccessful.

Table 6.--Wholesale sales of catfish, by fresh and frozen categories and by month, 16 processing plants in the South, 1970

Month	Processed catfish sold as wholesale						
	Fresh			Frozen			
	Volume	Price	Total	Volume	Price	Total	
	sold 1/	per pound	Value	sold 1/	per pound	Value	
	Lb.	Dol.	Dol.	Lb.	Dol.	Dol.	
January.....	116,406	0.94	109,837.85	296,193	0.84	248,983.45	
February.....	133,746	.95	127,353.05	386,929	.82	318,595.55	
March.....	110,063	.92	100,995.85	260,740	.81	210,539.15	
April.....	58,199	.93	53,949.95	195,899	.79	154,604.70	
May.....	23,633	.94	22,183.00	58,210	.81	47,228.50	
June.....	55,159	.92	50,767.60	47,705	.80	38,349.25	
July.....	64,833	.89	57,539.55	84,701	.79	67,189.69	
August.....	94,869	.88	83,214.65	64,397	.79	50,663.32	
September.....	157,924	.88	139,582.05	79,694	.79	63,322.38	
October.....	341,995	.88	301,759.70	97,843	.79	77,774.63	
November.....	351,050	.89	311,043.45	118,814	.79	94,119.68	
December.....	333,496	.89	298,114.60	108,479	.80	86,604.70	
Total	1,841,373	.90	1,656,340.30	1,799,604	.81	1,457,975.00	

1/ Dressed and processed.

#### WHOLESALE PRICE AND QUANTITY BEHAVIOR OF CATFISH AT THE INDUSTRY LEVEL 4/

The quantity of commercial catfish purchased for processing in 1970 varied from a low of about 96,000 pounds in May to a high of 1.2 million in February (table 8). This resulted in the quantity of processed fish available

4/ Analysis of the price-quality relationship of catfish is provided in the appendix.

Table 7.--Retail sales of catfish, by fresh and frozen categories and by month, 16 processing plants in the South, 1970

Month	Processed catfish sold as retail					
	Fresh			Frozen		
	Volume	Price	Total	Volume	Price	Total
	sold 1/	per pound	Value	sold 1/	per pound	Value
	Lb.	Dol.	Dol.	Lb.	Dol.	Dol.
January.....	1,038	1.10	1,141.80	3,315	0.92	3,056.25
February.....	1,071	1.10	1,178.10	3,200	.92	2,958.50
March.....	520	1.10	572.00	2,995	.92	2,746.75
April.....	700	1.10	770.00	2,382	.92	2,179.70
May.....	1,000	1.10	1,100.00	1,600	.96	1,530.00
June.....	1,000	1.10	1,100.00	900	.92	830.00
July.....	500	1.02	510.00	1,100	.90	990.00
August.....	900	1.01	910.00	900	.91	820.00
September.....	2,500	1.00	2,490.00	2,600	.89	2,315.00
October.....	3,140	1.00	3,135.00	2,992	.88	2,633.60
November.....	3,105	1.00	3,090.00	2,850	.88	2,510.00
December.....	2,525	.99	2,510.00	2,350	.87	2,035.00
Total.....	17,999	1.03	18,506.90	27,184	.91	24,604.80

1/ Dressed and processed.

for sale varying from about 56,000 to 706,000 pounds in these 2 months. Sales totaled 84,443 pounds in May, compared with 524,946 in February. Because the quantity of processed catfish available for sale and the quantity sold were not equal by months, inventories were accumulated. In February, the industry processed 181,454 pounds in excess of sales; in April, it sold 119,184 pounds from inventory. These variations in sales relative to quantity processed caused the industry's inventory to reach a maximum of 228,188 pounds by the end of February. The inventory did not drop to rather low levels until midyear.

The industry began in February 1970, with carryover of almost 47,000 pounds of catfish, in addition to about 706,000 pounds being available for sale. Only 77 percent of the fish available for sale were sold. In March, the beginning inventory was at its annual peak of approximately 228,000 pounds. The quantity of fish available for sale totaled an additional 344,000 pounds. Although more fish were sold in March than processed, the difference was not sufficient to reduce the inventory appreciably. The price fell 3 cents. The inventory at the beginning of April was almost 198,000 pounds. While this inventory was large, the industry sold 86 percent more fish than were processed in April, causing the inventory to drop appreciably. The price rose 2 cents per pound.

Table 8.--Levels of selected variables of the commercial catfish industry, by month, 16 processing plants in the South, 1970

Month	Retail price paid	Volume purchased <u>1/</u>	Volume sold		Total sales	Volume available for sale <u>2/</u>	Ratio of volume sold to volume available	Monthly change in inventory	Inventory
			Wholesale	Retail					
	<u>Dol./lb.</u>	<u>Lb.</u>	<u>Lb.</u>	<u>Lb.</u>	<u>Lb.</u>	<u>Lb.</u>	<u>Pct.</u>	<u>Lb.</u>	<u>Lb.</u>
January.....	0.96	799,459	412,599	4,353	416,952	463,952	89.9	46,734	46,734
February.....	.97	1,217,931	520,675	4,271	524,946	706,400	76.9	181,454	228,188
March.....	.94	593,005	370,803	3,515	374,318	343,943	108.8	-30,375	197,813
April.....	.96	237,924	254,098	3,082	257,180	137,996	186.4	-119,184	78,629
May.....	1.01	96,040	81,843	2,600	84,443	55,703	151.6	-28,740	49,889
June.....	1.02	147,141	102,864	1,900	104,764	85,342	122.7	-19,422	30,467
July.....	.94	223,748	149,534	1,600	151,134	129,774	116.5	-21,360	-9,107
August.....	.96	246,388	159,266	1,800	161,066	142,905	112.7	-18,161	-9,054
September.....	.94	422,254	237,618	5,100	242,718	244,907	99.1	2,189	-6,865
October.....	.94	780,304	439,838	6,132	445,970	452,576	98.5	6,606	-259
November.....	.94	819,599	469,864	5,955	475,819	475,367	100.1	-452	-711
December.....	.93	772,123	441,975	4,875	446,850	447,831	99.8	981	-270
Average.....	.959	529,659	303,414	3,765	307,180	307,225			

1/ Live weight.

2/ Assumed dress-cut rate (58 percent of volume purchased).

The 5-cent increase in price that occurred in May was the result of two factors. First, industry inventory, which had dropped for three successive months, was becoming relatively small. Second, purchases by processors reached their annual low in May, resulting in only 55,703 pounds of processed fish being available for sale that month. In April, 257,180 pounds had been sold. Since the inventory and the amount available for sale in May were considerably less than the amount sold in April, the inventory decreased and exerted an upward pressure on price. The price increased 1 cent in June for the same reasons.

During the last four months of 1970, the quantity sold and the amount available for sale were essentially equal and the price tended to stabilize. In an infant industry with demand relationships unknown, a situation in which the monthly quantity demanded is approximately equal to the quantity supplied indicates the industry is probably moving toward some longrun equilibrium. The commercial catfish industry appeared to be in this situation during the last 3-4 months of 1970.

### CRITICAL ECONOMIC FACTORS

The success of any industry and the level of return derived from investment in an enterprise depend to a great extent on the industry's capacity for production and the extent that these facilities are used. This statement is particularly relevant to the catfish processing industry in the South.

On the basis of information supplied by the processors, this section identifies significant factors and problems encountered in catfish processing operations: (1) Supply of catfish for processing, (2) processing capacity, (3) dressing and processing, (4) utilization of byproduct, and (5) areas of production. The data were not collected to make a complete analysis of the industry. Rather, the major purpose is to describe existing conditions of catfish processing with emphasis on certain critical economic factors that affect the industry.

#### Supply of Catfish for Processing

Obtaining a constant supply of catfish for processing poses a serious problem, especially to larger processing plants. Eleven of the 16 plants had difficulty in obtaining a constant supply of fish. The remaining five plants were small operations which usually produced much of their fish or had a small number of producers supplying small quantities of fish regularly.

The following tabulation of comments received from processors on problems in obtaining a constant supply of fish reveals the more serious obstacles in catfish processing:

Processors' Comments on Problems in Obtaining Fish	
Comment	No. of plants answering
1. No problem	5
2. No comment	1
3. Problem in obtaining fish in summer	7
4. Short of capital and had to buy slowly	1
5. Fish not available within hauling distance	1
6. Unable to get supply under several managements	1

Only six of 16 processors lost part of their supply because of competition from other plants and live haulers. Some of these maintained that the offer of free harvest by other plants caused their producer to sell to competing plants.

In most cases, the difficulty of obtaining fish in summer months caused several plants to cease operations completely for 3 or more months. In practically every plant, the amount of catfish processed in the summer months dropped considerably from the output during the rest of the year.

Some consideration has been given to processing plants contracting with producers to regulate the supply of catfish and to assure the processor of a constant supply of fish. Only two processing plants indicated that they had entered into contract with producers. The total live weight of catfish marketed to these processing plants through contract amounted to 1,200,014 pounds.

The important factor of variation in supply of live fish, by month and season, influences the operation of a successful processing facility. Much of the low utilization of processing facilities discussed previously is directly related to a shortage of fish for processing in certain months in 1970.

Only eight of the 16 processing plants operated with some volume for the entire 12 months of 1970. Although all these plants reported a much lower supply in summer months than in others, they were able to purchase enough fish to supply part of their regular market outlets.

Catfish purchased in January, February, and March accounted for 41.0 percent of the total volume purchased for processing (table 9). The months of April, May, and June only represented 7.6 percent of total purchased volume. The first 3 months of the year and the last 3 months accounted for 78.4 percent of total purchases.

Thirteen of the 16 plants reported purchasing fish for processing in the first quarter of the year; all 16 plants processed fish in the last quarter. Only 10 plants processed fish in the second quarter.

Table 9.--Volume of purchases and sales of catfish, by 3-month intervals, 16 processing plants in the South, 1970

Time period	Volume purchased <u>1/</u>	Proportion of total purchases	Volume sold <u>2/</u>	Proportion of total sales	Plants reporting
	<u>Pounds</u>	<u>Percent</u>	<u>Pounds</u>	<u>Percent</u>	<u>Number</u>
January through March.....	2,610,395	41.0	1,316,216	35.7	13
April through June.....	481,105	7.6	446,387	12.1	10
July through September.....	892,390	14.0	554,918	15.1	12
October through December.....	2,372,026	37.4	1,368,639	37.1	16
Total.....	6,355,916	100.0	3,686,160	100.0	--
<u>1/</u> Live weight.					
<u>2/</u> Processed.					

The sale of processed fish by season followed the same pattern as the volume of fish purchased for processing. The widest variation occurred in the first two quarters of the year. The proportion of sales reported in January, February, and March amounted to 35.7 percent of total sales, while these same months accounted for 41.0 percent of volume purchased for processing. The proportion of sales for April, May, and June was 12.1 percent, compared with 7.6 percent of live weight purchased. According to data in tables 6 and 7, a larger proportion of processed fish was frozen and then held over and probably sold in the second quarter. In the last quarter of the year, the proportion of fish purchased was almost equal to the proportion of sales in this period. The fact that during this quarter a larger portion of total sales was sold as fresh fish and was sold immediately after processing or stored for a few days may account for this finding.

#### Processing Capacity

Another major problem affecting the economical operations of catfish processing facilities is the low rate of utilization of the available processing capacity. Data presented previously revealed that 15 processing plants operated at approximately 29 percent of their potential capacity. However, the actual capacity of operation differed widely according to the size of facilities.



The five processing plants with a capacity of less than 3,000 pounds each reported a total possible annual capacity of 1,500,000 pounds of live weight (table 10). Their actual output in 1970 was 431,693 pounds--approximately 29 percent of their potential annual capacity. The four plants in the category of 12,000 pounds and over had an estimated potential annual production volume of 11,000,000 pounds. Their actual output was 4,249,271 pounds--approximately 39 percent of capacity. The other six plants (medium-size category) reported a potential of 8,832,000 pounds, compared with actual output of 1,672,202 pounds--approximately 19 percent of their estimated annual capacity.

In February--the month of peak production--1,217,931 pounds of live weight catfish were processed by the 15 plants. The estimated processing capacity was 1,707,200 pounds. Therefore, in the peak production month, these plants were only operating at approximately 71 percent of their actual capacity.

Table 10.--Estimated and actual processing capacity, and amount of average investment, by size of plant, 15 processing plants in the South, 1/ 1970

Size of plant <u>2</u> / (pounds)	Estimated full capacity <u>3</u> /	Actual capacity <u>4</u> /	Proportion of full capacity	Average investments <u>5</u> /	Plants reporting
	Pounds	Pounds	Percent	Dollars	Number
Small--less than 3,000.....	1,500,000	431,693	29	42,800	5
Medium-- 3,000-11,999....	8,832,000	1,672,202	19	146,666	6
Large-- 12,000 and over.....	11,000,000	4,249,271	39	517,500	4
Total.....	21,332,000	6,353,166	30	--	15

1/ One plant did not report its full capacity.

2/ Size is determined by volume of live weight that can be used in one 8-hour shift with present facilities.

3/ Full capacity is volume done in one 8-hour shift for 250 days at 80 percent of peak capacity.

4/ Actual capacity is the volume in live weight actually processed in 1970.

5/ Average investment is the total estimated value of building and equipment for the processing facility.

The five plants in the small category (less than 3,000 pounds) used 38,080 pounds of live fish in February, compared with their estimated capacity of 120,000 pounds. These plants operated at approximately 32 percent of capacity in this month. The four larger plants (over 12,000 pounds) processed 999,206 pounds--119,206 pounds greater than their estimated full capacity of 880,000 pounds for February 1970. These plants were therefore operating at approximately 113 percent of their capacity, indicating that at least some of these plants had to work more than 8 hours per day or they used more labor than reported for the 8-hour shift.

The average investment has little meaning for this discussion other than to reveal the costs of establishing various sizes of plants. However, the investment must be recovered in the longrun operation, and the full use of facilities is an important factor in recovering this cost. A facility operating for 1 year at only 19 percent of capacity is almost certain to have difficulty in recovering investment costs for a relatively low margin product such as catfish.

### Dressing and Processing

The cleaning and processing functions of the facilities varied considerably, according to data collected from 15 processing plants. <sup>5/</sup> The handling of live fish and methods of cleaning are important factors in facility organization and development. It is difficult to determine, however, at this stage of the industry's development, any definite advantage of one method of cleaning and processing over another.

It was not possible to determine the difference in dressing and processing costs among the three types of dressing reported. Some plants changed types of machinery during the year and, in many cases, experiments such as different arrangements of machinery took place. However, some data were obtained that could be useful for determining the type of dressing facilities best suited for certain conditions.

Six processors used hand labor only in their dressing operations. These plants rated their capacity at 29,700 pounds (live weight) of fish per 8-hour shift in which 68 persons were employed for the dressing and cleaning operation (table 11). Based on this information, each employee dressed an average of 437 pounds (live weight) in 8 hours, or 54.6 pounds per hour.

Seven processors used machines only for dressing and had a rated total capacity of 63,000 pounds per 8-hour shift. Each employee dressed an average of 578 pounds per 8-hour shift, or 72.2 pounds per hour.

Two plants used both hand labor and machines to process their total capacity of 14,000 pounds per 8-hour shift, which averaged 467 pounds per man per shift, or 58.3 pounds per hour.

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<sup>5/</sup> One of the 16 plants did not estimate its full capacity, and the data from this plant were omitted from this discussion.

Table 11.--Volume of catfish processed per man and per hour using different dressing methods, 15 processing plants in the South, 1970

Dressing method	Processing capacity <sup>1/</sup>	Total employees <sup>2/</sup>	Volume for one man in 8 hours	Volume per hour per man	Plants reporting
	<u>Pounds</u>	<u>Number</u>	<u>Pounds</u>	<u>Pounds</u>	<u>Number</u>
Hand.....	29,700	68	437	54.6	6
Machine.....	63,000	109	578	72.2	7
Machine and hand.....	14,000	30	467	58.3	2
Total.....	106,700	207	--	--	15

<sup>1/</sup> Estimated capacity with present equipment in one 8-hour shift.

<sup>2/</sup> Only labor involved in skinning, cleaning, and storing--no clerical or administrative personnel.

Again, data were unavailable to make detailed calculations of the total costs of hand labor and machine use. However, the data collected indicate that the type of dressing facility influences the volume of fish processed. A more detailed study of this phase of the processing operation could reveal important economic information concerning the use of machine and hand dressing.

### Utilization of Byproduct

The byproduct of catfish processing amounts to 40-45 percent of the live weight of fish purchased. If an economic use of the byproduct were devised, the returns of the processing operation would be greater. In 1970, only five facilities reported selling their byproduct--usually, for only 2-3 cents per pound. Ten plants made no effort to utilize the waste and reported hauling it away or giving it to someone to remove it from the premises. Only one plant reported utilizing this product by grinding it into fishmeal. At the present time, there seems to be no alternative economic use of the byproduct of catfish processing.

### Areas of Production

The nine States included in this study represent two distinct areas of catfish processing. The States in Area I--Arkansas, Mississippi, and Louisiana--were involved in commercial catfish production prior to those in Area II--Georgia, Alabama, South Carolina, North Carolina, Tennessee, and Florida. For convenience of comparison in the following discussion, these areas will be referred to as Area I and Area II.

Six of the 16 processing plants were located in Area I and produced 51.2 percent of the total catfish output of the nine States involved in the study (table 12). The 10 plants located in Area II produced 48.8 percent.

Table 12.--Volume and price per pound of catfish processing sales, by area and month, 16 processing plants in the South, 1970

Month	Area I <u>1/</u>		Area II <u>2/</u>	
	Volume	Price per	Volume	Price per
	processed	pound	processed	pound
	<u>Pounds</u>	<u>Dollars</u>	<u>Pounds</u>	<u>Dollars</u>
January.....	184,813	0.88	232,139	0.87
February.....	217,379	.87	307,567	.85
March.....	264,649	.84	109,669	.84
April.....	203,450	.81	53,730	.87
May.....	67,357	.84	17,086	.90
June.....	87,193	.86	17,571	.91
July.....	85,823	.83	65,311	.84
August.....	104,794	.85	56,272	.84
September.....	124,715	.86	118,003	.85
October.....	198,483	.86	247,487	.87
November.....	190,160	.85	285,659	.87
December.....	159,936	.85	286,914	.88
Total.....	1,888,752	.85	1,797,408	.86

1/ Arkansas, Mississippi, and Louisiana.

2/ Georgia, North Carolina, South Carolina, Alabama, Florida, and Tennessee.

The two areas varied very little in the volume of fish marketed in the first quarter of 1970. Area I marketed 35.3 percent of its total sales in these three months, and Area II marketed 36.1 percent of its total. However, a wide difference in the proportion of sales between these two areas did occur in the last quarter of the year. Only 29.0 percent of the combined sales of the plants in Area I were marketed in these months, compared with 45.0 percent of the total sales of Area II. The second quarter sales for Area I amounted to 18.9 percent of total sales in the area, while plants in Area II sold only 4.9 percent of their total sales in this period.

The annual and monthly prices received by plants in the two areas varied slightly. The greatest variation in monthly price occurred in June, when the average price received by Area I plants was 86 cents per pound, compared with an average price of 91 cents in Area II.

## POTENTIAL OF THE COMMERCIAL CATFISH INDUSTRY

In our attempt to determine the potential of the catfish industry in the South, the processors were asked their opinions on various aspects of the industry. Each question and a summary of answers and comments are provided below.

### Do you expect an increase in catfish production in this area in 1971?

All 16 processors answered this question affirmatively. However, many qualified their response by stating that certain conditions had to exist or continue to exist to have the expected increase. Five general comments were:

- (1) If price to producers is high enough.
- (2) Great deal of interest in producing catfish.
- (3) If market and price hold, expect a sizable increase.
- (4) Can already see signs of increase.
- (5) Efficient producers are increasing; some small producers are ending production.

### Do you believe your present market outlets can move an increased supply of fish?

All 16 processors believed they could move more fish through their present market connections, but many again made comments about certain conditions that would determine the amount of increase they could expect. Eight general comments were:

- (1) If price to distributor and consumer could be lowered, sales would definitely increase.
- (2) If producers will increase production for price they now receive.
- (3) Possibility for growth in delivery route if processors can meet all competition in selling price.
- (4) If price could be lowered 15 cents per pound, competition of imported fish could be met.
- (5) If price could be lowered 10 cents per pound, the broker could double the amount he is now marketing.
- (6) Refusal of orders because of lack of facilities and supply.
- (7) Need a constant supply at a lower price--supply in summer is difficult to get.

(8) More farm-raised catfish could be marketed from this plant.

Are you satisfied with present supply of catfish in this area?

Six processors said they were satisfied with their present supply of catfish; 10 were not. The six with affirmative answers came from plants processing a small volume of fish; the 10 negative answers came from larger plants.

Some reasons for the negative answers to the supply question are as follows:

- (1) Severe shortage of fish in summer.
- (2) Shortage of supply of fish from local producers.
- (3) Shortage of supply of fish to process every month--could use more.
- (4) Have not tried to develop increased supply yet--will wait and see.
- (5) Hope supply will increase in 1971---if price and market hold up.

Are you satisfied with present catfish market situation in this area?

Twelve processors were satisfied with the market situation; four were not. Comments on the market situation are as follows:

- (1) Margin between buying and selling price is too low.
- (2) Could market more if supply were available.
- (3) Plan to start retailing more to ensure continued market.
- (4) Could market more if could process more (lack of facilities and supply).
- (5) Would like to contract with brokers to handle supply.

Is present margin between prices paid and received sufficient to cover costs?

Eleven of the 16 processors answered this question affirmatively but they also stated they were only covering their costs and had very little, if any, profit. Five processors indicated that their margin was insufficient to cover their costs, so they were losing money each month. The recorded comments of both groups regarding their financial operations are as follows:

- (1) Low margin between cost of processing and marketing--can barely cover these costs.

- (2) Price to producer too high for any profit after processing and marketing costs added.
- (3) Margin could increase if facilities could be fully utilized for entire 12 months.
- (4) Price to special customers is good; could make a profit if all sales were on this basis.
- (5) Can continue to make some profit under the same conditions.
- (6) Small profit--processing facilities belong to a coop, and operates as a means of selling producer members' production--plant only tries to cover operating costs.

If selling price could be lowered, could you increase your volume of sales?

All processors indicated they could increase their volume of sales if they could lower their selling price. The following comments were recorded on the effect of a lowered selling price:

- (1) Increase sales to restaurants and retail stores; in all cases, consumers would buy more fish.
- (2) Help increase sales, but a constant supply would still be necessary.
- (3) Allow processors to compete with imported fish.
- (4) Possibly sell more live fish from holding tanks at processing plant.
- (5) Smaller plants could compete more favorably with larger plants.

Do you definitely intend to change capacity of processing facilities in 1971-72?

Eleven of the 16 processors indicated they definitely planned to change their processing capacity in 1971 or 1972. Five plants reported they expected to remain at their present processing capacity and wanted to see an increase in supply before making any definite plans to change. The general comments of all 16 plants were grouped into the following comments:

- (1) Enlarge facilities if producer price is lowered, or if sales increase, or if supply increases.
- (2) Add another processing line if price holds up.
- (3) Enlarge facilities and increase production of live fish on own land to increase supply for processing.

- (4) Build a new plant in another location with a larger processing capacity.
- (5) Will definitely enlarge operations--take a chance based on faith and belief in the growth of the industry.

#### NEED FOR ADDITIONAL RESEARCH

All processors asked to express their opinion about the type of research they believed would assist the entire catfish industry. The processors offered many opinions and ideas on this subject. Their remarks were summarized into 11 general categories of research. The following tabulation shows these categories according to the number of plants requesting such research.

#### Research That Would Assist the Industry Most

Research wanted	No. of plants requesting
Management and efficiency of producers	12
Processing technology (better skinning machines, etc.)	9
Breeding (genetics, etc.)	7
Marketing--consumer preference	5
Harvesting technology	3
Marketing--general	3
Marketing--new uses for catfish as a food	2
Problems associated with supply	1
Better quality of fish	1
Transportation facilities (live fish)	1
Marketing--future for the industry	1



As shown in the foregoing tabulation, 12 of the 16 processors requested research on how to improve the efficiency and management of catfish producers. They believe that better management would result in producers being able to sell catfish to processors at lower prices. The processor could then pass on this saving to the consumer by charging a lower price for the finished product.

Nine plants indicated that research on development of better skinning and dressing equipment could increase the efficiency of their operations. The category of research receiving the third highest number of requests concerned breeding and genetics--which could lead to a greater supply of catfish.

All processors expected an increase in catfish production in their respective area and, in general, believed that the potential for the catfish industry was good. Some maintained that certain conditions had to exist before a greater volume of production and processing could be achieved. Most expressed concern over the lack of a constant supply, high prices to producers, poor marketing conditions, and poor equipment for the processing industry.

The catfish industry is still in its early stage of development, and much individual experimenting is taking place. Of utmost importance is the need to provide the processors with a constant supply of fish so they can operate their facilities 12 months a year. The existing plants could then process three times the volume they were able to obtain in 1970. There still is much uncertainty among processors regarding the marketing practice or practices that are best for the catfish industry. More research also is needed on potential demand for catfish in other areas of the country.

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## APPENDIX

### ANALYSIS OF PRICE-QUANTITY RELATIONSHIP

#### Regression Estimates of the Price-Quantity Relationship

Monthly data on the price and quantity of a specific item observed in a single year may not be sufficient to trace out a supply or demand curve and estimate price and quantity relationships. This is especially so in an infant industry like catfish processing. To estimate a demand curve, demand should be relatively stable with the supply variable.

Least squares regression was used to smooth the data collected on catfish processing. Numerous equations were estimated, 1/ two of which are reported:

$$\hat{p}_t^r = 100.0 - 0.959 Q_t^r \quad N = 13; R^2 = 0.28 \quad (1)$$

$$\begin{matrix} \boxed{1.98} & 2/ \\ (10) & 3/ \end{matrix}$$

$$\hat{p}_t^r = 99.0 - 0.00873 Q_t^{w+r} - 0.00879 Q_{t-1}^c \quad N = 11; R^2 = 0.37 \quad (2)$$

$$\begin{matrix} \boxed{1.38} & \boxed{0.63} \\ (20) & (<50) \end{matrix}$$

Where:

$P_t^r$  = Retail price (cents) in  $t^{th}$  month

$Q_t^r$  = Quantity (1,000 pounds) sold retail in  $t^{th}$  month

$Q_t^{w+r}$  = Quantity (1,000 pounds) sold wholesale and retail in  $t^{th}$  month

$Q_{t-1}^c$  = Change in inventories (1,000 pounds) during  $(t-1)^{th}$  month

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1/ Wholesale price was not observed over a wide range of value. Estimates of relationship between wholesale price and various quantity variables were inconsistent with theory. Estimation models, including imports, change in inventory, and a zero-one variable for positive change in inventory, resulted in nonsignificant estimates of the parameters.

2/ Brackets enclose t values.

3/ Parentheses enclose level of significance. The value 10 implies that there is a greater-than-90 percent chance that the estimated coefficient for  $Q_t^r$  equation is not zero. The less-than-50 level of significance in equation (2) indicates that there is a greater-than-50 percent chance that the estimated coefficient of  $Q_{t-1}^c$  is zero. However, the sign for this coefficient is consistent with expectations and the variable was left in the model.

Equation (1) indicates a negative relationship between price and quantity of retail sales. Equation (2) indicates that the quantity sold wholesale and retail is negatively related to retail price and that positive changes in inventory tend to reduce price.

The  $R^2$  values for equations (1) and (2) are relatively low, indicating that other variables not included in the model influence the dependent variable or that the relationship between the variables was not consistent over the data.

When data of several years--at least 3 or 4 years--become available on the industry, the distributed lag techniques of Nerlove (5) or an autoregressive structure should be appropriate for this type of demand analysis.

In a study of demand for bread, Moriak and Logan (4) used a first-order autoregressive model with monthly per capita demand for bread formulated as a function of its own price, per capita disposable income, and the seasonal variation represented by  $\sin \theta t$  and  $\cos \theta t$ , where  $\theta$  equals 30 degrees because each month represents  $360/12$  degrees of the total cycle and  $t = 1, 2, \dots, 12$ . A similar technique could be used to test for seasonality in demand for commercial catfish.

#### Another Estimate

Since the regression estimates were disappointing, estimation by another technique was attempted. Large shifts in supply aid in the identification of shortrun demand. Working (7) has shown how shifts in supply functions aid the identification of the demand functions and vice versa.

The use of an unusual circumstance in the real world to aid identification of shortrun demand and supply relationships has precedent. Tolley (6) used the packinghouse workers strike of 1948 to develop demand and supply elasticity estimates for the hog industry. Langham (3) used the Florida freeze of December 1962 to estimate the demand for citrus products. The difficulty with these techniques is that probability statements about the estimated coefficients may not be possible.

Economic theory states that the price of a product in a given market at a given time is determined by the intersection of a supply and demand curve (see fig. 1). If during some month, we observe that two units were sold at an average price of 10, we would expect this observation to occur at the intersection of some demand curve  $D_1$  and some supply curve  $S_1$  (Point A, fig. A1). And, if in some other month, we observe that five units sold at an average price of 4, our principle of price determination would show that this observation was at the intersection of some supply curve  $S_2$  and some demand curve  $D_2$  (Point B, fig. A1).

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<sup>4/</sup> The sine and cosine variables estimate the amplitude  $\sqrt{b_3^2 + (b_4)^2}$  of the cycle and the phase angle  $\arctan (b_3 / b_4)$ , where  $b_3$  and  $b_4$  are the estimated coefficients for  $\sin \theta t$  and  $\cos \theta t$ , respectively.<sup>5</sup>

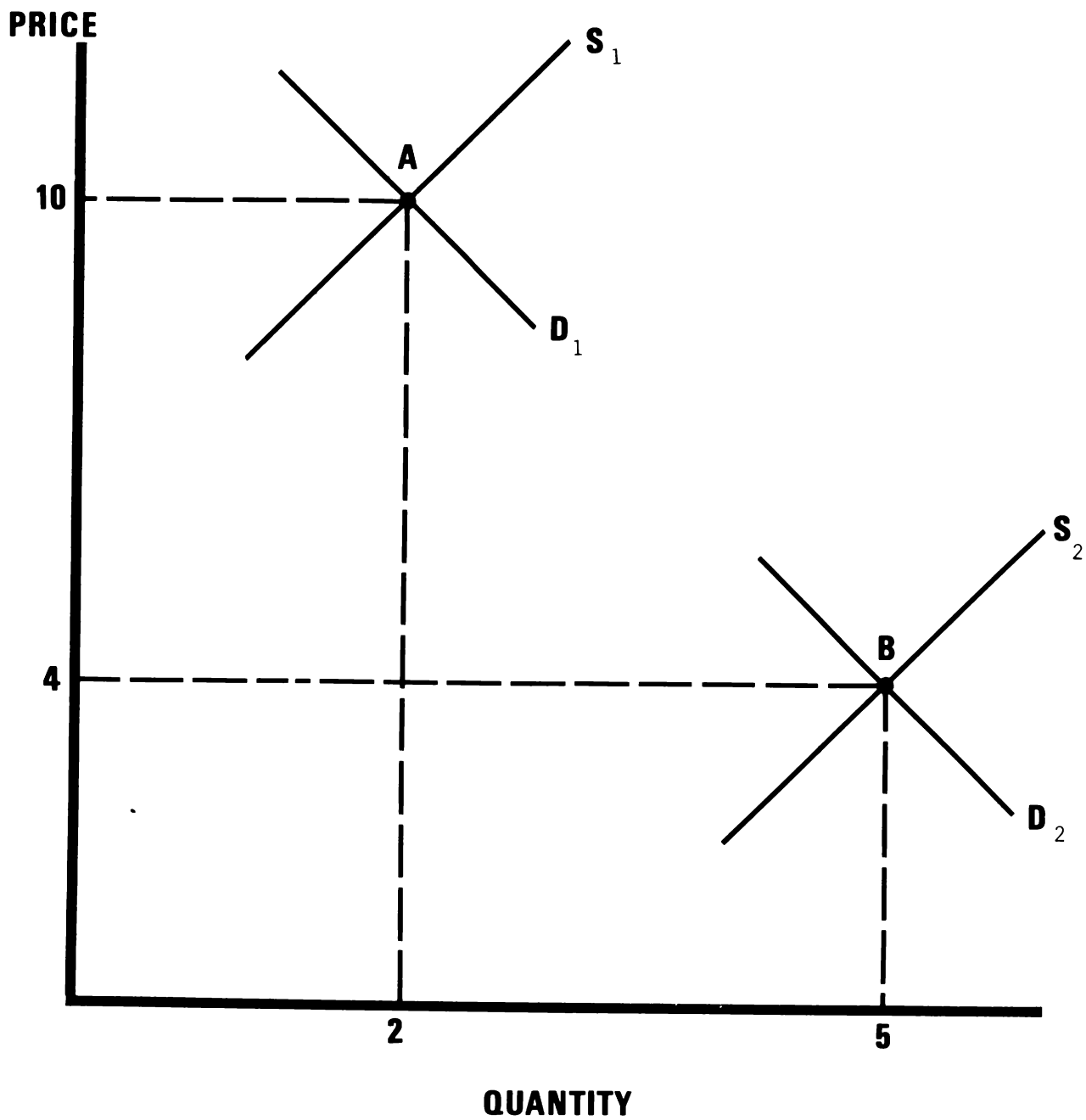


Figure A1.--Hypothetical graph showing price determination at two points in time.

If the second price-quantity observation differs from the first because of a shift in supply while the demand remained stable,  $D_2$  would not be a separate distinct demand curve but a continuation of  $D_1$ . Points A and B would be on the same demand curve.

In this problem, we have observations on price and quantity of commercial catfish for 1 year (1970). The developing industry lacked any knowledge about the equilibrium price. Several price adjustments occurred during the year. It is doubtful that the demand for catfish changed significantly over the period of time covered by the data. For this reason, we assumed that the data for portions of the 12 months are relevant to the estimation problem.

Early in the year, the relationship between retail price and quantity sold was probably obscured by the large industry inventory. By the fifth and sixth months, inventories reached their first rather stable low levels for the year. Considering only the last 8 months (when inventory levels were rather low), the tenth, eleventh, and twelfth months are viewed as months of large supplies. Relative to these months, supplies in the fifth and sixth months were small. By averaging the retail price and quantity sold for the fifth and sixth months, Point E, (fig. A2) was determined. Point F (fig. A2) was calculated by averaging the same variables for the tenth, eleventh, and twelfth months. The following equation was determined by converting these points:

$$\begin{array}{rcl} \text{Price} & = & 103.549 - .02166 \text{ Quantity} \\ \text{retail} & & \text{sold} \end{array} \quad (3)$$

where price is measured in cents, and quantity in thousands of pounds.

Equation (3) indicates that an increase in quantity sold of 100,000 pounds causes retail price to decline approximately 2 cents. Equation (3) possibly presents the relationship between retail price and quantity sold based on data available. The procedure (estimation of demand relationship from two points) assumes that demand is not seasonal, that is, that quantity demanded given a price does not vary by month. If demand is seasonal or if the demand curve shifted during the year, the demand situation may not be well identified by the data or this procedure.

An economic analysis that considers only the demand side of the picture is only half complete. Information is needed on the cost structure associated with producing, harvesting, processing, and selling catfish before intelligent conclusions and/or recommendations can be made. These cost estimates, similar to demand estimates, are needed for a range of quantities. The foregoing price-quantity relationships were estimated on the basis of prices and quantities observed in 1 year. We would like to have such estimates for longer periods, perhaps showing even larger changes in supplies that we have experienced. This, of course, is impossible with data on past experience. We also need estimates that allow a longer adjustment period to price changes.

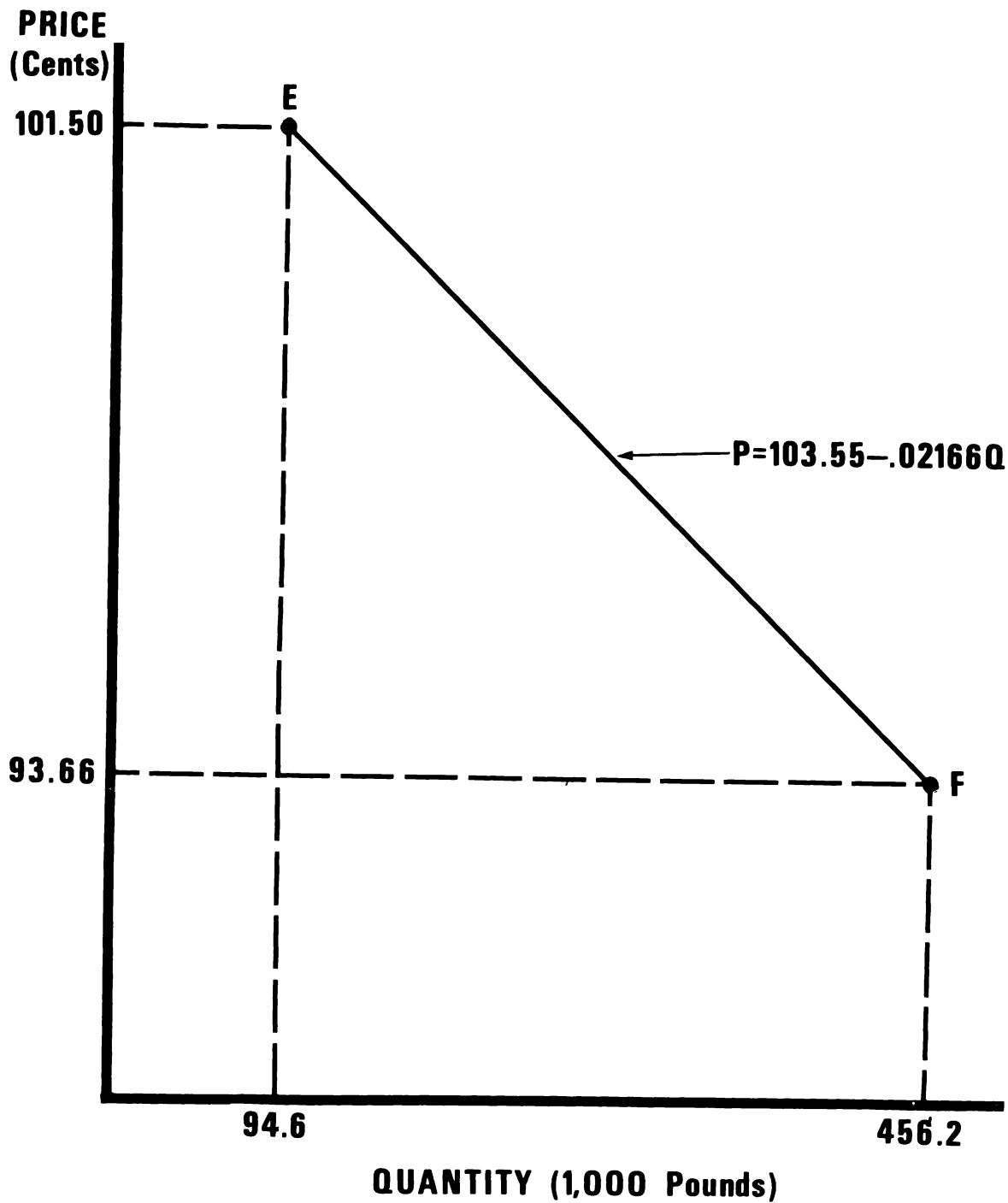


Figure A2.--Graph indicating estimated relationship between retail price and total sales for commercial catfish.